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MENTAL IMAGERY IN GEOGRAPHY

What is the origin of our mental imagery of the world as a sphere? Do we get it from the earth itself? The view on a large flat plain, or on an extended water surface where the shore line is out of sight, has, it is true, a visible circular horizon. If, however, we seek to extend the view by gazing from a mountain top, or from an aeroplane, even at a height of two or three miles, we see nothing that looks to the eye even remotely like a sphere. Although we have an enlarged circular horizon, yet we do not get far enough away from the earth to see its real shape. In other words, we cannot include enough of the earth in our view to see that it is a sphere.

If, however, we watch the boats pass out of sight over the horizon, or come up into view on the lake or ocean, while it is still true that we do not see any round earth, we are, nevertheless, forced to imagine a sphere in order to explain what we do see. This image, however, even here, cannot come from the view we get of the earth.

If, further, we circumnavigate the globe, do we thereby get a sense-impression of a round earth? We may, indeed, by this experience, increase tremendously the vividness and the trustworthiness of our mental image of a spherical earth. For example, nothing else will so much aid us in thinking correctly of the huge size of the planet. But even that much is due entirely to an effort of thought in connecting our experience of travel with our preconceived mental image of a sphere. Columbus, with an exceedingly wide experience on the ocean, concluded that the earth was pear-shaped.

We are not here concerned with the proof that the earth is round, but with the question whether we can get a sense-impression of a round earth from the earth itself.

If we observe an eclipse of the moon, we see the shadow of the round earth pass over the disk of the moon. We see, it is true, that the shadow is circular in cross-section. Does that give us an image of the spherical earth?

The moon is the most favorably situated of all the heavenly bodies for our observation. It is near enough for us to see its shape. To the naked eye it does often look like a flat disk, it is true. Through a telescope, however, it certainly looks spherical. The changing phases

of the sun's illumination emphasize the appearance of roundness. The relief of its bespattered surface helps to make the appearance of sphericity more clear and vivid. We may use our sense-impression of the moon in making our mental image of the earth.

It will scarcely be questioned, however, that for most of us our mental image of the spherical earth is derived by sense-impression from pictures, maps, or globes. If we image the earth as a sphere at all, it is a model of the earth that we image instead of the earth itself.

If, now, we ask ourselves whence come our mental images of continents, oceans, and countries, we must again confess that they also are all too large for our eyes to see as a whole, and, even though we may travel over every square mile of their surface, their shape still eludes us, until we construct an outline or a model of them on a scale small enough for us to take in at one glance the whole of the region.

It is perfectly true, however, that we may associate into one mental image innumerable sense-impressions by constructive imagination without the intervention of an objective model. Perhaps this is the true origin of the mental image most people have of their home town or country neighborhood. Many a person, though well acquainted with his neighborhood, cannot find his way on the map, and not infrequently finds, on consulting a map, that his mental image was greatly distorted and even false in many respects. It is, of course, quite impossible to build up, test, and correct the mental image by measurement of lines and angles, observations of latitude and longitude, triangulation of the area, etc., as the drawn map is built up, tested, and corrected.

We may, therefore, safely conclude that all accurate and correct mental images of the shape of the earth, shapes of continents, oceans, islands, peninsulas, bays, gulfs, lakes, river courses, boundary lines, states, mountains, plateaus, as well as the geological formations, location of cities, harbors, parks, railroads, canals, etc., are developed in our minds from the study of maps and models. These images cannot be had by a study of only the things themselves. Except in the matter of small details which concern an area small enough to be seen at once, it is even impracticable for an ordinary person to check up a map and test its accuracy. He depends on the map, rather, to correct his observations than vice versa.

I believe, therefore, a radical fault in our geography teaching lies in the neglect of maps and models. They should claim a much

larger share of careful study in order to provide these elementary mental images of geography, since these latter cannot be obtained from the study and observation of the great outdoors itself.

It is a well-known fact, moreover, that a large proportion of our maps and models are distorted reproductions of the real things. For instance, the projection of the spherical earth on to a flat map necessarily distorts its shape. All the methods of projection are struggles to minimize an inevitable difficulty. The Mercator projection for world maps is the worst distortion in shape that is used. The flat map on any possible projection, for even so large a portion of the earth's surface as a continent, is a serious distortion. Hence, flat maps should be limited to areas at least as small as the United States, in order to preserve, approximately, the actual shape.

Moreover, teachers should be very suspicious of the value of the false images children obtain from working out exaggerated relief on sand-tables or putty maps. It is usually pleaded for these that it has been explained to the pupils that the relief is exaggerated, since it would be too slight to represent at all on the same scale as is used for horizontal distances. Distorted mental images thus obtained are, nevertheless, not "corrected" by such verbal explanation, and persist, since they cannot be tested by comparison with reality itself. For these small models themselves are the source of our mental images inasmuch as the actual world features are inaccessible to our observation on any possible scale that would enable us to see them. Hence our false distortions are not recognized as false, since we have nothing true to compare them with. Even learned geographers have sometimes defended these distortions, on the ground that they represent the earth as it really looks to us at close range. The heights of mountains, they say, seem exaggerated in comparison with horizontal distances in a landscape. The slope of a hill seems much steeper than it really is when measured. Nearly every one draws a mountain far steeper than any mountain-slope usually is. On the other hand, however, I believe the truth to be simply that our distorted relief models and exaggerated diagrams have caused these misconceptions of the mountain-slope and heights that have, in turn, been urged as a reason for continuing the use of the distortions.

On the same ground I question the wisdom of the exaggeration of any physical features whatever in a map or model. In this connection it is to be recalled that practically all our school maps at present

greatly confuse the images they present by the mass of names printed on them and grossly misrepresent the width, shape, and number of rivers, the number and the size of railroad tracks, the size and shape of cities, and the prominence of political boundaries; at the same time, they usually fail to bring out the facts of soil, geology, wooded and farming areas, industries, trade-routes, etc., that are closely connected with the geographical mental image that we should get from a map. Of course, special maps must be used to show separate features in detail, but still it is very desirable also to combine in one map, large enough to avoid confusion, every sort of characteristic possible to assemble that is intrinsically necessary to the understanding of the life of the inhabitants of the region. A large detailed map with a multiplicity of data may indeed be so arranged as not to be confusing if prominence be given to large things, and minor things be kept in proper subordination. In general, everything should be on the scale of the map. Instead of making names so large as to be read across the room, I would have the names on a key map only, or so small on the other map that they could be seen only close at hand, as signs on buildings are seen. I would have three series of maps; namely, first, detailed maps to show specialized features with names; second, maps on a very large scale without names, or with only the smallest details named in very fine capitals, these being planned more as bird's-eye views, with everything in proper proportion, to be viewed close at hand for detail and at a distance for the general view and for larger features; and third, key-maps with names for reference, much as our usual maps now have the names on them.

What part of our mental imagery, on the other hand, can be traced to direct sense-impression of the actual world about us?

First, the landscape as we travel over the surface of the earth is undoubtedly direct sense-impression of the real world. It should, however, always be interpreted by maps. An observer with a map can see more things and note more relations than one without, because by the map he perceives at once whence and whither roads lead or streams flow. Thus he sees beyond the mountains or the woods that obstruct the view, and corrects the mistaken appearances due to the foreshortening of objects. In this way the map at once gives an exactness to his observation that even months of study without a map could not give. We must, therefore, never forget that, while it is undoubtedly true that the first-hand study of the surface of the earth is indispensable

to all geographical imagery worthy the name, still, nevertheless, many or even most of the relations can be brought into our sense-perception only by maps or models. Instead, therefore, of field trips, excursions, or travel taking the place of map-study, they are, on the one hand, what make map-study possible and profitable; and, on the other hand, they are themselves enriched tenfold by having their direct observation rectified, extended, and related to the thousands of other facts which, though set down on the map, are not observed in the landscape.

Thus only can we make a success of our excursions and field-trips. By preparing for excursions through a study of maps and by tracing out one's course during and after the trip, by representing in picture, diagram, and model what we see and have seen, we may associate into one related whole the sense-impressions that belong together, even where these were either too large or too disconnected in observation for the relations to be perceived. Thus, a field trip to a mountain fold may give in half an hour all the sense-impressions of the outdoor scene that are later to be worked over in map, drawing, and delta-table modeling for days thereafter. The reproduction shows parts of the earth's crust and represents portions of the landscape that were not seen in the field-trip, and hence it supplements and interprets the scenery of the field-trip.

The ordinary landscape view that a traveler gets from the car window or from a country road is not very extensive. However, as the train crosses a mountain pass, or as the road leads around or over a hill, the view broadens. In general, the more we can see in one view, the more interesting and instructive it is. When a great valley, with cities, railroads, rivers, farms, woods, mines, factories, etc., lies spread out before our eyes, as from the top of Lookout Mountain in Tennessee, or at Grand View on the Allegheny escarpment in Pennsylvania, we have in such an actual view of the real earth's surface a combination of what we otherwise would have to piece together from a succession of detailed near views by careful map study. These bird's-eye views are ideal maps, except for two reasons: first, we should look down on the country vertically to avoid the foreshortening of the sidelong, horizontal view; and, second, the haze and clouds usually obscure the view, and the distance renders objects indistinct. These faults are remedied in a map that shows everything as it would look from a point directly overhead.

Just as such views are valuable in getting a true idea of a great

stretch of country visible from one point of view, so it is very desirable that minor outlook points be visited for the view of smaller areas. The view from the Woolworth building in New York or the City Hall in Philadelphia or the Bromo-Seltzer Tower in Baltimore or the Washington Monument in Washington, D. C., or the Eiffel Tower in Paris, gives a sense-impression of a great city that cannot be obtained in any other way. Such views bring things into association because they are combined in one observation. For other areas, however, we must think the thousands of things in question into relation by the study of maps. The mental imagery of a map is the concrete basis of our thinking these thousands of relations among the hundreds and thousands of facts represented on a map.

If, on the one hand, the earth is too near for direct study without maps, so, on the other hand, the stars and planets are too far away for study without models. Thousands of observations are necessary to collect the facts expressed in a model of the solar system. The model shows the relation of the facts directly to the senses. In the heavens, however, those relations escape our observation because of the size and distance of the objects and the limitation of our sight to but a small part of the heavens at any one time. It helps, therefore, our conception of the daily rotation of the sky about the earth if we step into the Atwood Celestial Sphere* and see that model of the heavens rotate in five minutes.

When we consider how little of the fundamental imagery of geography can be had merely from direct observation on trips, excursions, travels, bird's-eye views from outlook points, or observation of the heavenly bodies, we are likely to be more duly impressed with the indispensable role played by maps and models in the creation of geographical imagery.

In our school, therefore, we supplement our excursions and field-trips with not only ordinary maps, but floor maps. In our fifth-grade room the floor is covered with plain linoleum in which is carved a map of America north of the equator. The scale is twenty miles to an inch, for convenience in measurements. The rivers are tooled out of the linoleum by small gouges. The cities are represented by brass shapes nailed on. The mountains are also of metal, while the pointed tack-heads symbolize the heights of mountain peaks. There

*The Atwood Celestial Sphere at the Chicago Academy of Sciences is a great hollow globe into which one enters to see the apparent rotation of the heavens about the earth.



THE FLOOR MAP LOOKING NORTH FROM THE GULF OF MEXICO

are no names, but literally thousands of facts are represented. The relations of these facts to one another are better represented than in an ordinary wall map, because: (1) The map is ten times as large as any ordinary wall map. (2) It lies in conformity with the points of the compass. North on the map is north on the earth out of the window. (3) The pupils can walk over the map, thus getting their muscular sense and sense of direction associated with the regions on the map. They can step from state to state, can walk from New York to California, or from Alaska to Panama, and get an orientation that is impossible from a map that is merely looked at on the wall. (4) Standing at Chicago on this map, the pupil has spread out around him a *direction key* to all North America. He has but to point in the direction of New York, Hudson Bay, San Francisco, Cuba, Panama, South America, or the Bermudas on the map, and further out over his horizon in the real world lie any or all of these in precisely the same direction as he is pointing. (5) The floor is where children naturally love to play, and hence on the floor map. It lends itself to numerous forms of play, permitting a whole class to participate at once in active exercises on its surface. Thus rail and water transportation routes, with toy trains and boats, make the real appeal of sense-impression. The corn, wheat, and cotton areas, forest areas, geological formations, mining districts, manufacturing cities, etc., are chalked in by pupils from reference maps, and for history the routes of explorers and areas of claims and treaty boundaries are similarly marked. Colored cords on pins, stuck in the map, are also used to show explorers' routes, ice-sheet edge, snow-sheet extent from week to week, isobars, or storm areas. The weather of the United States has been represented by the children, each taking a station—a boy for cloudy weather and a girl for fair—standing to face the direction in which the wind was blowing, as reported on the United States daily weather map. A standard marked "High" or "Low" is placed over the area around which centers the anticyclone or the cyclonic storm. Thus the ascending spiral bringing rain or snow, and the descending spiral bringing fair weather, may actually be pictured through the senses and made clear to a fifth or sixth grade pupil. We sometimes cut out circular discs to scale, to represent state areas or population of states or cities, the number of bushels of wheat, corn, or other crops produced in each state, and then have the fun of laying them out on the proper part of the map, thus giving a sense of relative values of



THE SCHOOL GARDEN AT CALIFORNIA, PENNSYLVANIA, LAID OUT AS A MAP OF THE UNITED STATES

regions, such as is afforded by the maps in the Statistical Atlas of the Census. We have illustrated the growth of population from decade to decade, by using small dolls to represent inhabitants, by placing them on the map where their number would correspond to the increase of population.

For the campaigns of the Colonial Period, the Revolution, and our later wars, the floor-map lends itself as the theater for representation, with lead soldiers and other toy forms as natural aids.

When the opportunity for using a half acre of ground as a school garden presented itself some years ago,* it was laid out as a map of the United States, with paths on the State boundaries. To some extent, the idea of the growing-crops map at the St. Louis Exposition was followed. Cotton was raised in Georgia, tobacco in North Carolina, wheat in the Dakotas, corn in Iowa, orange trees in California and Florida. In general, however, the children renting the states raised what crops they chose.

The fundamental concepts of direction and distance are obtained most clearly from large models over which one may walk. Both concepts are derived from the sensation of movement, and are far clearer and more usable when that movement is locomotion. When we are on the map, just as we are on the surface of the earth, then we may actually see the sun rise in the east over New England, south at noon over Chicago, and set in the west behind the Rocky Mountains and California. The north star is north on the garden map, and the heavens revolve around it. This gives association of experience with the different portions of our country akin to those of actual travel. Every morning, when the children came to the garden, they saw the sun shining on the map in the east, and pointing his shadows toward the west. They would often sit on the Pacific coast in the evening and see the lengthening shadows thrown eastward by the orange trees that they themselves had planted and irrigated.

After twilight they would watch the North Star in the north from different positions on the garden map. The moon traveled across the heavens above our model states, just as she sails over the real ones of earth.

The children grew used to tracing the state boundaries as they ran about the map. They became expert in thinking of the direction of

*At the Practice School of the Southwestern State Normal School, California, Pennsylvania.

one state or city from another, because they had so often stood at the city in one state and looked or run in the direction of the other city or state. Similarly, with distances. When they are daily running about the states, they get the relative sizes of the states and distances from point to point fixed in their mental imagery by muscle memory as well as by eye memory.

This sort of motor sense-impression is very different from that derived from little book maps held in the hand, or from maps hanging on the wall, where all sense-impression associated with a map is false and has to be laboriously corrected by reasoning from memory images. Most of these false associations of maps are never considered by teachers, and few children ever consciously correct sense-impression by memory images.

Far greater interest attaches to the large map, not only because it is clearer but because the children can play with it and on it. Even a little boy in the lowest primary grade learned the states by hunting apples hidden in the different states. The children readily invented games to play on the map, and found an added zest in the freedom of learning. They played hide-and-go-seek, follow-the-leader, or located cities, mountains, rivers, etc.

The added clearness was very forcibly shown by the many questions the children asked about details of the large map that never would have occurred to them in even the most detailed study of book maps.

A large map of the United States in relief, laid out as a park with some attention to the growing crops and mountain flora, with actual water in the great lakes and the Mississippi River, with the cities marked in cast iron models, as they are in that charming model of Palestine at Chautauqua, New York, would teach more geography than all the other apparatus ever made, and while not too expensive for any city of over fifty thousand people, would make any such park a world-famous spot until such models become common in other large cities. It should commend itself even to landscape gardeners as far to be preferred to formal geometrical gardening, just as pictures are preferable to wall-paper designs.

The apparatus, however, that is nearest to being a living model is the delta-table with running water. Here is seen, first, river erosion with shifting channel, the formation of sand-bars, bank erosion, cutting down of the bed of the channel, delta-formation, flood-plain,

meanders, and cut-offs, wearing of down-stream side of curves, together with the erosion of the outside and deposition on the inside of stream curves. Secondly, the destruction of lakes is shown by filling up from all inlets and draining off by cutting down of outlets. Thirdly, the recession up-stream of waterfalls and rapids can be watched from day to day. Fourthly, the shore lines of former lakes and old lake bottoms can be traced here on the delta-table, so that excursions to the old shore lines of Lake Chicago become intelligible even to fifth-grade children. Fifthly, we study the action of running water in sorting sand and gravel and the bedding of the resulting deposits. The whole subject of underground water, springs, and wells can be made clear by demonstrations on the delta-table. We made a working model of a canal-lock, and took toy boats through. We have used the table for miniature landscapes in staging battles and frontier scenes, the plantation life of the Colonial Period, as a model of Niagara Falls, to show tidal changes, etc. The delta-table is indispensable as a means of sense-impression for all of these various geographical images which otherwise could come to the pupils only by extensive travel, long continued adult observation, in widely separated parts of the country, and with enormously increased expenditure of time.

For the development of the imagery of a spherical earth, it is necessary that young pupils have daily familiarity through both sight and touch with as large a globe as practicable. We have a very serviceable home-made model (diameter, 52 inches) of the northern hemisphere. This is so suspended as to turn readily. It is large enough to make plausible to the senses the idea that a round earth can be so large that a limited area will look flat. We calculate the size of a manikin standing on this model and representing a man six feet tall as only seven-millionths of an inch in height. A railroad train half a mile long would scale down to three-thousandths of an inch on the model. The head of a common pin is larger than the ordinary horizon of our model manikin. This sort of building up of accurate scale imagery should accompany the use of all maps and models. It has a fascination, too, for the imagination of the child akin to that of the story of Gulliver among the Lilliputians.

Accurate relief models without exaggeration need to have as large a scale as practicable, and hence must represent but small areas. Such can be built up by cutting out folio maps of the geological sur-

vey on the contour lines and building up the elevations by layers. Some few relief models, those by Howell, for instance, are available that do not very grossly exaggerate height. The pictured relief-map, Nystrom's for example, has been greatly improved in recent years by Thorne Thomsen, and has some advantages over actual relief models.

After all, however, the greatest dependence in geographical teaching must be on large, accurate, detailed maps with everything drawn to scale, and with nothing, even to the lettering of names, out of proportion. For convenience in using such maps, they must be suspended vertically, as their nature makes it impracticable to walk over them. They are for reference, hence names in small capitals should be found on all details, as roads, towns, railroads, parks, factory plants, rivers, locks, lakes, hills, mountains, bluffs, islands, bays, forests, mines, quarries, etc. These names should not be so large nor so conspicuous, however, as the representation of the objects themselves.

On the other hand, for the development of the mental imagery of a region, no maps with names are so well adapted as are blank maps, graphically showing the features of the country in great detail, but having no names on the larger features. The map names are undoubtedly a great distraction to the attention. Most people give their chief attention to the names on a map and fail to see many of the relations shown. More of us would know the states in the United States if maps more usually omitted their names. No one knows a region very well, if he cannot find his way on a good map without having the larger features named. There is no excuse for covering up the surface of a map with the state names, names of cities of over one hundred thousand inhabitants, names of the great lakes, the large rivers, the chief mountain ranges, etc. Anybody who does not know these should study a smaller key-map of reference. Any map should have only such names on it as the users are not expected to know without being told.

To sum up, I have pointed out the fact that the mental imagery of even the most fundamental geographical concepts originates in maps and models, not merely in observation of the actual world about us, and that it is maps and models that give accuracy to all our outdoor observations in traveling or on field-trips. I have, therefore, urged that we improve our material by providing larger maps, making true models free from exaggeration, giving far greater detail and ac-

curacy, and subordinating name to representation. I have used floor-maps and garden maps for their size and clearness in orientation. I have used the delta-table as the most valuable means of presenting the action of running water. I have urged the constant presence of the largest available spherical globe for the building up of a usable mental image of the round earth. Lastly, I have urged the importance of blank maps to show places and surface features in due proportion, free from the distraction of the large lettering in printed names.

